9.0 Lakeview, Oregon, Disposal Site

9.1 Compliance Summary

The Lakeview, Oregon, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site, inspected on June 24 and 25, 2008, was in good condition. The U.S. Department of Energy (DOE) continues evaluation of the durability of the disposal cell erosion control rock riprap and the infiltration of water into the cell. No cause for a follow-up or contingency inspection was identified.

Degradation of the rock riprap observed at the site since the mid-1990s has been monitored annually as part of the inspection to determine the mean diameter (D_{50}) of the riprap on the western side slope. The D_{50} value measured during the 2008 monitoring is 2.33 inches, which falls below the original D_{50} design size range of 2.7 to 3.9 inches for the side slope riprap. The 2008 D_{50} value is 0.01 inch greater than the value measured in 2007.

In 2002, DOE recalculated the original D_{50} value on the basis of newly available information and proposed a reduced D_{50} value of 1.8 inches. This information was submitted to the U.S. Nuclear Regulatory Commission (NRC) for concurrence in August 2002 in the draft revised *Long-Term Surveillance Plan* [LTSP] *for the U.S. Department of Energy Lakeview Uranium Mill Tailings Disposal Site, Lakeview, Oregon* (draft revised LTSP). In the interim, the NRC review of the draft revised LTSP remained pending. NRC visited the site during the 2008 inspection and subsequently submitted a letter to DOE suspending its review of the draft revised LTSP because the revised plan addressed rock size, but not rock durability.

An ongoing pilot study of monitoring percolation through the disposal cell cover (using water fluxmeters) is in its third year. Evaluation of the effects of deep-rooted vegetation on the performance of the disposal cell cover by modeling the movement of water through the radon barrier using water fluxmeters continues. An investigation of root intrusion and soil permeability has shown that tens to hundreds of centimeters of rainwater infiltrate through the cover during dry and wet years. Results of the pilot study indicate that percolation rates are high; these conditions raise concerns about cell performance as it pertains to contaminant isolation and slope stability.

DOE will initiate annual rock durability monitoring during the 2009 annual inspection to quantify the durability of the existing rock cover. Additionally, DOE will further evaluate the disposal cell cover performance to ensure that a long-term solution, which provides adequate erosion protection and continued isolation of the mill tailings, is identified and implemented, as necessary. This information will be incorporated into a new LTSP revision that will be submitted to NRC for review and concurrence.

9.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Lakeview Disposal Site are specified in the *Long-Term Surveillance Plan for the Collins Ranch Disposal Site, Lakeview, Oregon* (DOE/AL/62350–19F, Rev. 3, DOE, Albuquerque Operations Office, August 1994) and in procedures established by DOE to comply with requirements of Title 10 *Code of Federal Regulations* Part 40.27 (10 CFR 40.27). These requirements are listed in Table 9–1.

Table 9–1. License Requirements for the Lakeview Disposal Site

Requirement	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 6.1	Section 9.3.1
Follow-Up or Contingency Inspections	Section 7.0	Section 9.3.2
Routine Maintenance and Repairs	Section 8.0	Section 9.3.3
Groundwater Monitoring	Section 5.3	Section 9.3.4
Corrective Action	Section 9.0	Section 9.3.5

Institutional Controls—The 40-acre disposal site is owned by the United States of America and was accepted under the NRC general license (10 CFR 40.27) in 1995. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, is responsible for the custody and long-term care of the site. Institutional controls at the disposal site, as defined by DOE Policy 454.1, consist of federal ownership of the property, a site perimeter fence, warning/no-trespassing signs placed along the property boundary, and a locked gate at the entrance to the site. Inspectors found no evidence that these institutional controls were ineffective or violated.

9.3 Compliance Review

9.3.1 Annual Inspection and Report

The site, northwest of Lakeview, Oregon, was inspected on June 24 and 25, 2008. Results of the inspection are described below. Features and the photograph locations (PLs) mentioned in this report are shown on Figure 9–1. Numbers in the left margin of this report refer to items summarized in the "Executive Summary" table.

Seismic Activity—The Lakeview Disposal Site is located in a seismically active region. The United States Geological Survey National Earthquake Information Center notifies DOE when earthquakes of magnitude 3.0 or greater occur within 0.3 degrees (about 20 miles) of a disposal cell and when earthquakes of magnitude 5.0 or greater occur within 1.0 degree (about 70 miles) of a disposal cell. Although there were some seismic events near the site in the recent past (2005), no seismic activity was reported in 2008.

9.3.1.1 Specific Site-Surveillance Features

Access Road, Entrance Gate, Fence, and Signs—Access to the site is gained by traveling a gravel road that heads west off County Road 2–16B. The access road is in good condition. DOE was granted a perpetual easement on the 1.2-mile access road between the County road and the DOE property boundary. A DOE lock is on a cable gate across the access road at a cattle guard approximately 1,800 feet southeast of the site. A newly erected metal-sided building on privately owned land was observed north of the cable lock during the 2008 inspection. The building is apparently used as a storage facility.

A barbed-wire boundary fence surrounds the site and is in good condition. General fence repairs, including mending damaged and loose wire strands, were made in June 2008 prior to the annual inspection. An extra strand of wire was added in a few low places where there was past evidence of animals entering the site.

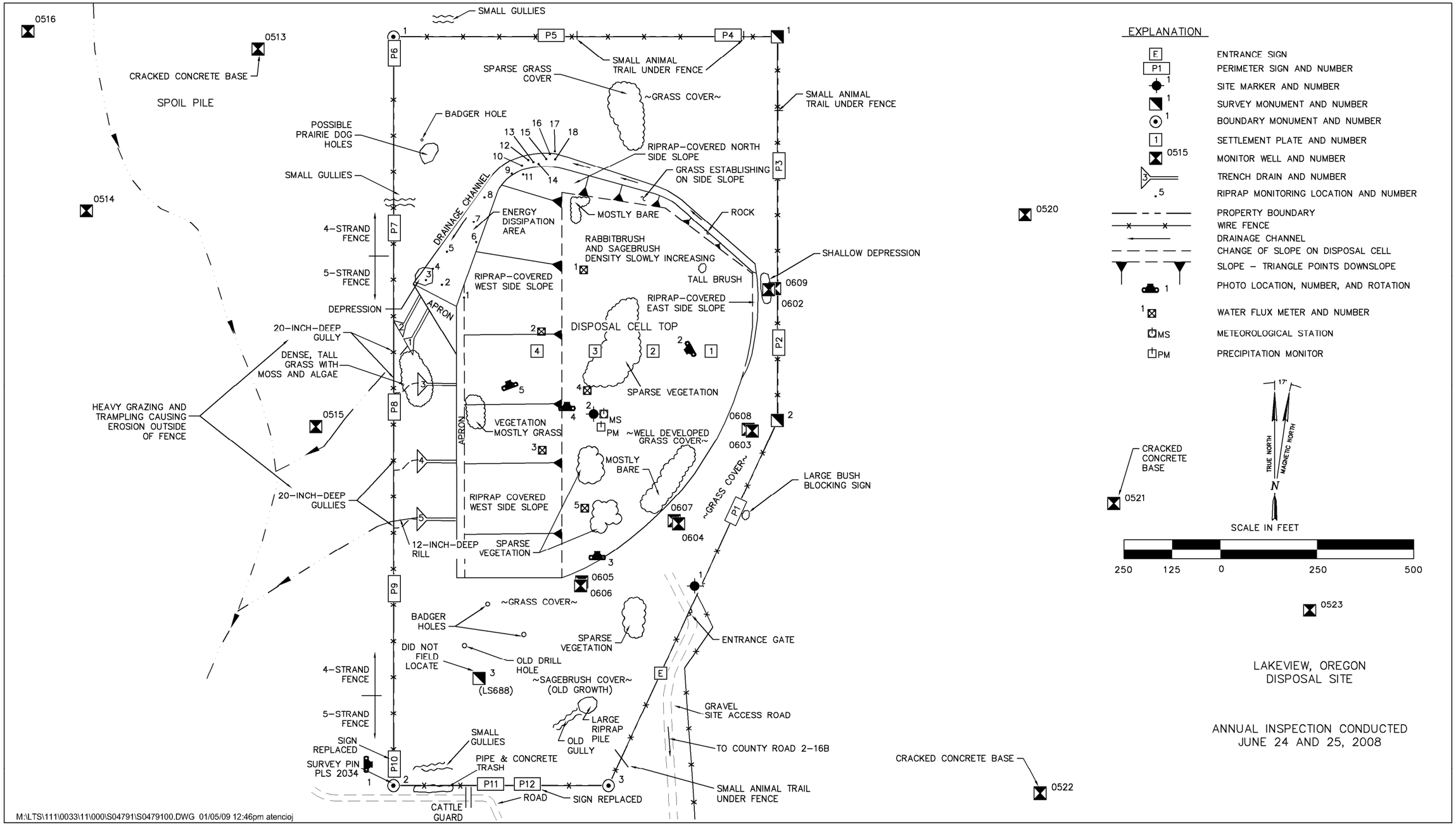

Figure 9–1. 2008 Annual Compliance Drawing for the Lakeview Disposal Site

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The entrance sign was in good condition. Two perimeter signs (P10 and P12) were replaced during the 2008 annual inspection (PL–1). The remaining 10 perimeter signs were in good condition. Perimeter sign P1 was obstructed by vegetation. It will be cleared or the sign will be moved during the next inspection.

Site Markers and Monuments—The two site markers, two of the three survey monuments, and the three boundary monuments were in good condition. Due to dense vegetation, survey monument SM–3 could not be field-located and, therefore, was not inspected. During the next inspection, the monument will be located using global positioning system equipment, and a T-post will be placed next to the survey monument to assist with future location.

Monitor Wells—Nine monitor wells are in the groundwater-monitoring network. Eight point-of-compliance (POC) wells (four monitor well pairs: MW–0602/MW–0609; MW–0603/MW–0608; MW–0604/MW–0607; and MW–0605/MW–0606) are located east of the cell; a compliance well (MW–0515) is located west of the disposal site. Seven additional DOE-owned monitor wells (MW–0513, MW–0514, MW–0516, MW–0520, MW–0521, MW–0522, and MW–0523) exist near the site but are not part of the compliance monitoring network. All 16 wells were inspected. They were locked and in fair-to-good condition. The concrete bases of monitor wells MW–0513, MW–0521, and MW–0522 are cracked, but the wells remain in acceptable condition.

9.3.1.2 Transects

To ensure a thorough and efficient inspection, the site was divided into three transects: (1) the top of disposal cell; (2) the side slopes of the disposal cell and adjacent drainage channel, aprons, and trench drains; and (3) the site perimeter and outlying area.

The area inside each transect was inspected by walking a series of traverses. Within each transect, the inspectors examined specific site-surveillance features, drainage structures, vegetation, and other features. Inspectors also looked for evidence of settlement, erosion, or other modifying processes that might affect the site's integrity or long-term performance.

Top of the Disposal Cell—The design for the top of the disposal cell has produced conditions that favor the growth of deep-rooted plants. The thin soil layer overlying a layer of rock on the top slope stores very little water; hence, most precipitation percolates deeper where it either drains laterally in the coarse sand layer or infiltrates the compacted soil layer (radon barrier).

The top slope was seeded with grasses, but the low water-storage capacity of the thin (nominal 4-inch-thick) topsoil layer has limited grass growth to scattered patches of deeper-rooted wheat grasses. The total vegetative cell cover has gradually increased over the years as patches of deeper-rooted grasses have spread (PL–2). Perennial and annual species, although limited, are also establishing on the cell top. Most of the top slope still has sparse vegetation compared to surrounding undisturbed plant communities, and bare areas still exist.

Movement of precipitation through the riprap and bedding layers and into the radon barrier also favors the growth of shrubs. Sagebrush, rabbitbrush, and bitterbrush, which are the dominant plant species surrounding the site, have been establishing on the top of the disposal cell. Shrub density likely will continue to increase until it approaches or exceeds levels observed in native plant communities adjacent to the site.

Disposal Cell Cover Performance Evaluation—Field investigations at the site indicate that a combination of soil development and root intrusion by the deep-rooted shrubs has increased the hydraulic conductivity of the radon barrier in the cell cover, allowing meteoric water to percolate into the underlying tailings.

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Encroachment by deep-rooted shrubs was observed shortly after construction of the disposal cell. As designed and constructed, the cover is a favorable habitat for deep-rooted plants. Root intrusion and soil development have increased the permeability of the radon barrier. In situ tests have shown that the saturated hydraulic conductivity of the radon barrier ranges between 1×10^{-6} and 1×10^{-4} centimeters per second (cm/s) (the design target was 1×10^{-7} to 1×10^{-8} cm/s).

In fall 2005, LM began an evaluation of a new device called a water fluxmeter (PL–3), a passive wicking lysimeter, to directly measure percolation flux through the Lakeview disposal cell cover. Three water fluxmeters installed in holes augered through the top slope of the cover and into tailings capture percolation just below the compacted soil layer in the cover. Monitoring results show significant percolation through the cover. Cumulative percolation averaged 996 millimeters during 2006, 186 millimeters during 2007, and 444 millimeters during 2008. These values are assumed to be greater than the mean percolation for the cover because the three water fluxmeters were intentionally placed in downslope locations where water accumulates in the sand drainage layers. The evaluation also includes monitoring of moisture content in the tailings. Tailings beneath the side slope of the disposal cell remained saturated during the entire 3-year period. The combination of high percolation flux and saturated tailings raises concerns about the potential for the leaching of contaminants and the protection of groundwater. DOE plans to evaluate the fate and transport of tailings constituents and associated human-health and ecological risks.

The saturated tailings are also an indication of a phreatic surface at about 5.5 meters below the side slope crest. A cursory evaluation conducted in August 2008 suggested that seismic activity might render the disposal cell slope unstable. This information is presented in *Demonstration of Water Fluxmeter at the Lakeview, Oregon, Disposal Cell: Fiscal Year 2008 Progress Report*. DOE will evaluate the need for further investigation of slope stability, the extent and depth of the phreatic surface, and the potential for liquefaction.

Additional information is available in *Demonstration of Water Fluxmeter at the Lakeview, Oregon, Disposal Cell: Fiscal Year 2008 Progress Report*.

Additionally, studies of natural systems in the area (natural analog studies) have provided evidence for scenarios of the long-term performance of the cover. Some inferences that have emerged from these natural analog studies follow:

- Plant succession and soil development on the cover may lead to even greater permeability of the radon barrier.
- Soil development and plant succession on the cover may also lead to an increase in evapotranspiration, keeping the radon barrier unsaturated and, hence, effectively offsetting the increase in permeability.
- As rock riprap on the cover is degraded, vegetation growing in the rocky soil that will likely develop on side slopes may be adequate for long-term erosion control.

Side Slopes of the Disposal Cell and Adjacent Drainage Channel, Aprons, and Trench Drains—The side-slope cover shows no sign of cell settlement, displacement, or slumping. The contact boundary between the cell top and side slopes show no evidence of vertical or horizontal movement (PL–4). Concerns about the size and durability of the riprap are discussed below in the "Riprap Condition Evaluation."

Encroachment of grass has increased in the riprap on the north side slope, in the upper (eastern) part of the drainage channel, in the energy dissipation area at the lower end of the drainage channel, and in the western apron area. Grasses in these areas are now well established. Relatively sparse plant growth in the drainage channel is not significant and does not degrade the function of the channel.

Standing water previously observed in the large depression in the energy dissipation area at the lower end of the drainage channel was absent during the 2007 and 2008 inspections. Water is a concern because inundation may accelerate deterioration of the large riprap due to freeze-thaw processes and secondary mineralization or alteration.

Riprap Condition Evaluation—Riprap for the disposal cell was sized to withstand the erosive energy of a probable maximum precipitation event—a conservative, worst-case scenario in which the most severe meteorological conditions possible occur at the same time. Deterioration of riprap on the west and north side slopes and in the energy dissipation area at the lower end of the drainage channel had noticeably increased since the mid-1990s. The deterioration is likely due to weathering processes and is an ongoing concern because the percentage of crumbling rocks on the surface indicated that the riprap may continue to deteriorate. DOE initiated annual riprap gradation monitoring of the west side slope in 1997.

As specified in the Lakeview LTSP, the original cell design required a D_{50} design range envelope for Type B side slope riprap gradation of 2.7 to 3.9 inches to ensure protectiveness of the cell from erosion. Upon evaluation of the up-dated hydrologic information for the site, DOE proposed a revision to the LTSP to reduce the riprap size requirement from the original design specification. DOE used a hydrologic computer model that was accepted by NRC to recalculate a proposed D_{50} value. The lower end of the revised D_{50} range necessary to protect the disposal cell was recalculated at 1.8 inches. The proposed recalculations were included in the draft revised LTSP, which was submitted to NRC in August 2002 for concurrence. As part of its review, NRC visited the site during the 2008 annual inspection. Following the visit, NRC submitted a letter to
9B DOE (dated July 23, 2008) stating: "DOE must consider both the durability of the rocks, in addition to the D_{50}. Because the issue of the riprap durability was not addressed in the DOE proposal to revise the LTSP, NRC will suspend its review. DOE should consider the options available and propose a solution that will provide sustained and adequate protection of the disposal cell from severe precipitation events."

DOE will initiate annual rock durability monitoring during the 2009 annual inspection to quantify the durability of the existing rock cover by estimating the percentage of rocks that are
9C durable, that are susceptible to near-term degradation, or that have already crumbled. This durability monitoring will be implemented in conjunction with the annual D_{50} monitoring, and the results will be reported in the annual inspection report.

DOE will further evaluate the cover design to ensure that a long-term solution is identified and implemented, as necessary, which will provide adequate erosion protection at the site and which is in compliance with all applicable cell performance requirements. This information will be incorporated into a new LTSP revision that will be submitted to NRC for review and concurrence. DOE has stated these intentions in a letter to NRC, dated October 17, 2008.

Gradation monitoring was performed on the riprap during the 2008 inspection of the west side slope for the 12th consecutive year (PL–5). Particle size distribution (weight percent) by count data was collected at 20 locations. An evaluation of the rock size measurements taken in 2008 indicates that the side slope riprap D_{50} is 2.33 inches with a 95 percent confidence interval between 2.14 and 2.52 inches (Figure 9–2).

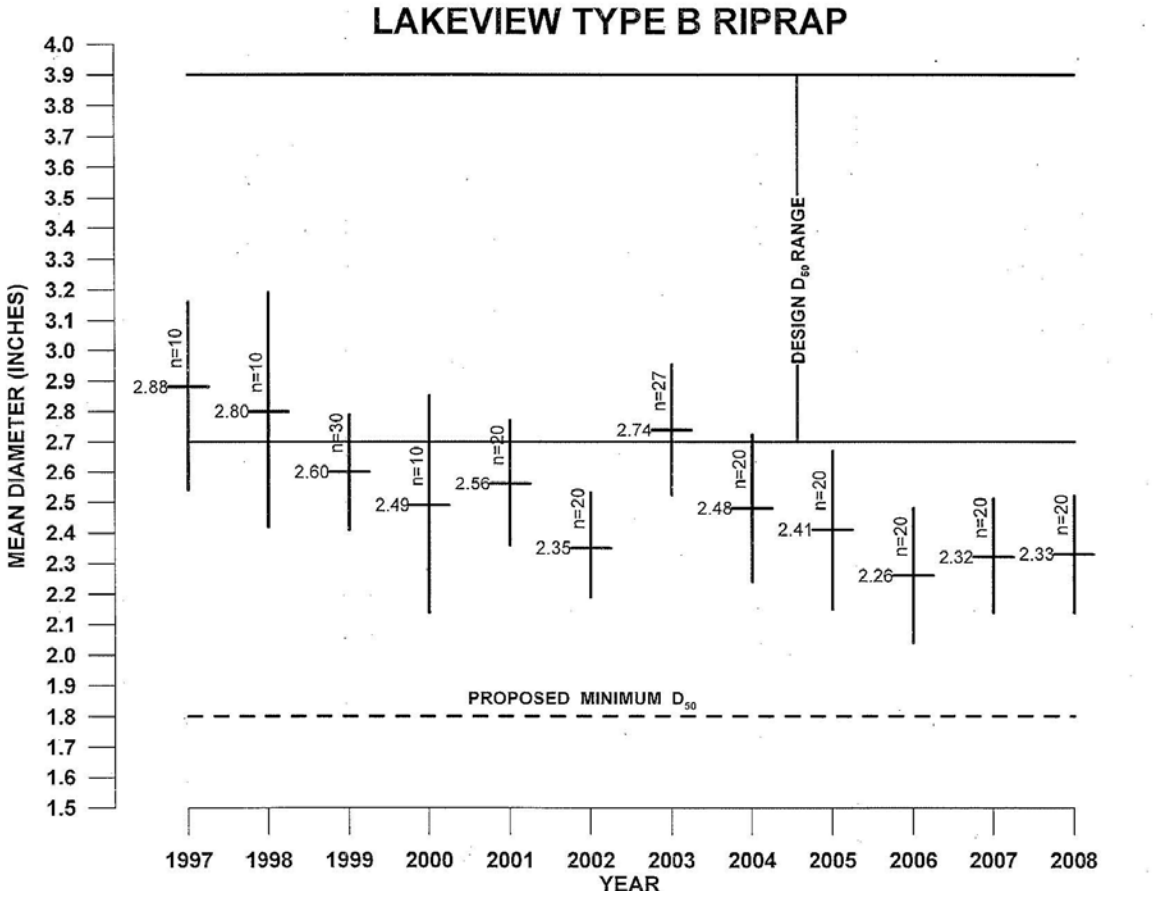

Figure 9–2. Side Slope Riprap Size Monitoring Results for the Lakeview Disposal Site

The 2008 result of 2.33 inches basically replicates the 2007 result of 2.32 inches. Annual values measured for the previous 5 years include the following: 2003 (D_{50} = 2.74 inches), 2004 (D_{50} = 2.48 inches), 2005 (D_{50} = 2.41 inches), 2006 (D_{50} = 2.26 inches), and 2007 (D_{50} = 2.32 inches). The mean D_{50} for the previous 5 years (prior to 2008) is 2.44 inches. The D_{50} values show a slightly upward trend since 2006, but overall, the cover rock size D_{50} from 1997 to the present has gradually decreased by about 20 percent. The initial, more rapidly decreasing trend may be because the basaltic rocks used on the side slope were predisposed to chemical or physical weathering and reacted more quickly to newly imposed surface conditions

during the first decade (1989 to 1999) after cell completion. Therefore, the first decade of rock weathering may have seen the greatest and most rapid loss of rock integrity.

The annual monitoring of the 18 photograph points for long-term rock monitoring was conducted in the energy dissipation area. The photographing of location 17 was inadvertently missed during the 2008 annual inspection. Rock degradation continues to be observed since monitoring began at the original 10 photographic locations established in 1997 and eight additional locations established in 2000. Monitoring location identifications were repainted during the 2008 inspection.

Site Perimeter and Outlying Area—This transect includes the area extending from the disposal cell to the site boundary and the area within 0.25 mile surrounding the site.

A small area (approximately 40 feet by 15 feet) located upgradient of the drainage channel near monitor wells MW–0602 and MW–0609 was observed as a shallow depression. The area was dry but showed evidence of previously ponded water (with a maximum depth of approximately 6 inches). The depression did not appear significant, and no repairs are recommended at this time. This area will be watched to see if ponding recurs.

Gullies that formed in seeded areas extending west of Trench Drains 1, 2, 3, 4, and 5 were filled with rock in 2000. The rock has mostly arrested the headcutting that was proceeding from the Collins Ranch property onto the DOE property. Small gullies observed forming downslope of the rock were not large enough to warrant repair at this time. Additional small gullies have been observed in the southwest corner of the site just inside the perimeter fence and downhill of an inclined road that intersects the fence line. These small gullies are likely the result of runoff from the road during rain events. The gullies did not show recent erosion and present no immediate cause for concern.

The area within 0.25 mile of the site boundary was unchanged from 2007.

9.3.2 Follow-Up or Contingency Inspections

DOE will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition, or (2) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed.

No follow-up or contingency inspections were required in 2008.

9.3.3 Routine Maintenance and Repairs

DOE performed minor fence maintenance and replaced two perimeter signs in 2008.

9.3.4 Groundwater Monitoring

DOE monitors groundwater quality in the uppermost aquifer at this site once every 5 years to demonstrate that the disposal cell is not leaching contaminants. The most recent sampling event was performed in 2004. No monitoring was performed in 2008. Constituents analyzed every 5 years include arsenic, cadmium, and uranium. Their respective maximum concentration limits (MCLs), established by the U.S. Environmental Protection Agency (EPA) in Table 1 to

Subpart A of 40 CFR 192, are 0.05 milligrams per liter (mg/L), 0.01 mg/L, and 0.044 mg/L, respectively. Concentrations of these constituents were well below their respective limits in 2004 and were consistent with sampling results from 1999. Based on the monitoring results to date, there is no indication of any degradation of groundwater in the vicinity of the site. The next cell performance monitoring is scheduled for 2009.

9.3.5 Corrective Action

Corrective action is taken to correct out-of-compliance or hazardous conditions that create a potential health and safety problem or that may affect the integrity of the disposal cell or compliance with 40 CFR 192.

No corrective action was required in 2008.

9.3.6 Photographs

Table 9–2. Photographs Taken at the Lakeview Disposal Site

Photograph Location Number	Azimuth	Description
PL–1	90	New perimeter sign P10.
PL–2	240	Disposal cell top.
PL–3	0	Water fluxmeter No. 5.
PL–4	0	Boundary of disposal cell top and west side slope.
PL–5	340	Rock gradation monitoring.

LKV 6/2008. PL–1. New perimeter sign P10.

LKV 6/2008. PL–2. Disposal cell top.

LKV 6/2008. PL–3. Water fluxmeter No. 5.

LKV 6/2008. PL–4. Boundary of disposal cell top and west side slope.

LKV 6/2008. PL–5. Rock gradation monitoring.

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